ASHRAE Thermal Comfort STEM Activity

INTRODUCTION

Thermal Comfort is an area of engineering for the designers of building heating and air conditioning systems to target conditions in buildings that will keep occupants comfortable.

What is thermal comfort? (What would the students say?)
Basic thermal comfort is not being too hot or too cold, but ASHRAE engineers have found six things that we can adjust to make buildings more comfortable. These are temperature, humidity, air drafts, hot and cold surfaces, what we're wearing and how active we are.

ACTIVITY: MEASURE THE THERMAL COMFORT OF YOUR CLASSROOM.

Materials: Thermometer, device reading relative humidity, infrared thermometer, paper and scissors. Invite an engineer to join you or supply some of these measuring instruments or see ASHRAE STEM kit for a sling psychrometer.

INSTRUCTIONS

1. **Temperature:** Measure the temperature in your room using a thermometer (not the infrared thermometer). Choose a spot near the middle of the room at a desktop. Try the desks in the corners of the classroom and the teacher's desk also. Is the temperature the same everywhere? Draw a grid representing your classroom and note the temperatures where you measured them in the part of the room where you measured them.
2. **Humidity:** Measure the relative humidity in the same places you measured the temperature. Note the relative humidity you measured in the grid from step 1.
3. **Air Speed:** Look for any location in your classroom where the air speed is high. Do this by cutting a standard piece of typing paper in fourths. Hold your hand out flat and lay the paper across your hand. Slowly move around the room and look for any place where the air is moving fast enough to lift the paper off your hand. Circle any part of the room on the grid from step 1 where the air speed was high enough to blow the paper off your hand.
4. **Hot and Cold Surfaces:** Using the infrared thermometer measure the temperatures of all the walls, the ceiling and the floor. Note these temperatures on the grid from step 1.
5. **Clothing:** Observe the amount of clothing worn by everyone in the classroom. Place tally marks next to the amount of clothing you observe. Think about a time the class has decided it's too hot or too cold in the classroom. What amount of clothing was everyone wearing?

   Pants/skirts: above the knee
   Pants/skirts: ankle length
   Shirts: no sleeves
   Shirts: short sleeves
   Shirts: short sleeves
   Any light jackets?
   Any heavy sweaters?

6. **Activity Level:** Think about any time the class has decided its too hot or too cold in the classroom. Which of the following were you doing at the time?

   Sitting quietly
   Standing, relaxed
   Exercising
   Writing
   Walking about
   Typing
   Tossing and catching

DISCUSSION

Typical indoor air temperature in conditioned spaces ranges from 70-75 degrees Fahrenheit, but sometimes we are uncomfortably hot in that range because it is too humid or too sunny or we are more active or wearing more clothing. Sometimes we are uncomfortably cold in that range because we are sitting next to a cold wall or window or there is a draft or we are wearing less clothing such as a dress with no sleeves.

Activity level: Classrooms should be comfortable for most of the activities listed on page 1. However, exercising usually requires a fan to keep people from getting warm.

Clothing: In a classroom, most students will need to wear at least shorts and short sleeves to be warm enough in the warm season. Some buildings will be cool enough to wear long pants year round. In the cold season, we need to be wearing at least long pants and long sleeves before we ask to have the temperature turned up.

Hot and Cold Surfaces: If the walls are 20 degrees F hotter or colder because of a window or because its hot or cold outside, that may be what is causing people to be too hot or too cold.

Air speed: When we are hot, air movement helps us feel more comfortable. When we are cold, air movement tends to make us more uncomfortable. The meteorological concept of "wind chill" is the same effect.

Humidity: Typically ranges from 40% to 60%. If relative humidity is above that range, spaces tend to feel hotter even if the temperature is the same as it is on dryer days , though air movement can counteract that feeling. If relative humidity is very low (<20%), there may be complaints of dry eyes and noses.

Temperature: As noted above, typically ranges from 70-75 °F. Is the room in that range? What temperature does everyone in the room like?

Is your room comfortable? Which of the above could you adjust to make your room more comfortable? What strategies do you use at home to keep comfortable? Are they different than what you are able to do in the classroom? Why/why not? Is it better to condition the person or the whole room? Why?

One more thing: When we come in from outside or we change our activity level, it can take us some time to be comfortable after the change. Don't decide its too hot or cold and change the temperature until you have adjusted. Use a fan if its been hot until you cool down or to leave on warm clothing if its been cold until you warm up. Also dress to keep warm when its cold outside.

Researchers have found that students don't do as well on tests when they are too hot or too cold. If you have shown that your space is uncomfortable enough to be distracting and you can't adjust clothing, activity level, hot or cold spots or air speed, it is time to ask the people who operate the building if they can make some adjustments.